

REMARKS

Claims 66-101 have been canceled and claims 102-134 have been added. Claims 102-134 are pending in the application. Reconsideration is requested in view of the amendments and the remarks to follow.

Originally-filed claims 13 and 38 were initially allowed together with claims 1, 2, 4-12, 14, 16-25, 34-37, 39-42 and 44-51. Following subsequent prosecution, Examiner Kielin required restriction in a telephone conversation with Mr. Mark Matkin, representing Applicants, in a telephone conversation on March 21, 2001, as stated in the Office Action dated March 23, 2001 at p. 3. In this Office Action, the Examiner acknowledged that election was accompanied by traverse (p. 3, Office Action).

In a response dated May 22 of 2001, Mr. Matkin affirmed the election. In an Action dated June 28, 2001, the Examiner canceled these claims as being drawn to a non-elected species. The Examiner indicated that election was made without traverse in paper no. 11. This is in error, as is plainly seen in the Examiner's Action dated March 23 of 2001. Applicants are not required to repeatedly affirm traverse. New claims 125 and 132 correspond to some aspects of the invention as recited in claims 13 and 38 as originally filed.

Claims 82-84, 87 and 98 stand rejected as not being enabled under 35 U.S.C. §112, 1ST ¶. New claims 104 and 105 include recitation of at least some of the aspects of the invention recited in claims 82-84 and 87.

New claim 120 includes recitation of at least some of the aspects of the invention recited in claim 98.

The Examiner expresses the opinion that there is no support in the specification as originally filed for "dry" oxygen-containing moieties being employed for oxygen exposure used to reduce the dielectric constant of the dielectric layer. The Examiner is mistaken on multiple grounds, as is explained below in more detail.

At lines 5-10, the term "oxygen-containing moiety" is defined to be "preferably a "dry" compound". The Examiner is referred to p. 7, lines 10 and 11, stating that "Such provides but one example process whereby water formation is avoided."

Subsequent, numerous recitations of different examples of the oxygen-containing moiety are provided, including plasmas formed from exemplary gases that obviously provide "dry" oxygen. Further examples are presented, inter alia, at p. 12, lines 15-21, stating that:

Where the invention is conducted in situ in a plasma enhanced chemical vapor deposition chamber subsequent to the deposition, the exposing might comprise substantially ceasing feeding of one of the reactive gases while maintaining a feed of one of the precursors which comprises oxygen, and thereby maintaining plasma conditions from the deposition through an extended exposure time with the oxygen containing precursor to achieve the exposing effect.

How does the Examiner propose that shutting off of one of the reactive gases while leaving a feed of the oxygen comprising precursor, which the Examiner admits is a "dry" oxygen moiety, could possibly fail to provide enablement for use of a "dry" oxygen comprising moiety for the

oxygen exposure? Accordingly, the 35 U.S.C. §112, 1ST ¶ rejection is inapposite to claims 104 and 105. The rejection should be withdrawn with respect to new claims 104 and 105 and new claims 104 and 105 should be allowed.

New claim 120 includes the phrase "at least" prior to "100 seconds". The 35 U.S.C. §112, 1ST ¶ rejection thus is inapposite to new claim 120. Accordingly, the rejection should be withdrawn with respect to new claim 120, and claim 120 should be allowed.

Rejections under 35 U.S.C. §103

Claims 81-101 stand rejected under 35 U.S.C. §103 as being unpatentable over various combinations of Morita and/or Brinker in view of Matsuura, and in some instances further in view of Miyasaka. Each of Applicant's new claims recite, in pertinent part, chemical vapor depositing a first layer over a substrate and the integrated circuitry of such substrate. In addition, such claims recite exposing such layers to an oxygen-comprising moiety in a plasma to provide an insulative layer.

In contrast, and as admitted by the Examiner, Morita does not teach chemical vapor depositing the dielectric. Rather, Morita teaches that such layer is applied as a liquid and subsequently solidified. Morita also teaches that the liquid layer is dispensed over a plasma CVD formed silicon oxide insulation layer 9 (Figs. 1 and 2 and the translation at p. 4, beginning 9 lines from p. bottom). Morita also teaches that such liquid

material is used as a planarization tool (see, e.g., text bridging pp. 4 and 5 and also text at p. 6 of translation). Specifically, Morita states that the inventors **combined the advantages of both silicon oxide films and spin-on glass thin films** (p. 3, continued from p. 2).

Morita teaches formation of a film using spin-on glass atop a CVD film because Morita teaches that (bottom of p. 1 of translation and extending to p. 2) "it has become difficult to embed an insulating film into the gap" between conductors and because "it is difficult to achieve planarization". As such, Morita is clearly aware of CVD films and teaches away from forming interlevel CVD dielectric layers. Additionally, it is a main intent and intended purpose of Morita to use the planarization properties of spin-on glass techniques.

Morita also teaches use of CVD silicon oxide as a first step towards preparing the substrate for spin-on glass deposition. Accordingly, Morita teaches away from formation of a dielectric film using CVD and plasma techniques, because Morita teaches that this does not facilitate appropriate planarization. Morita further teaches (p. 2) that organic silicon thin films do not provide adequate insulative properties.

Morita (i) teaches away from the subject matter of Applicant's claims and (ii) teaches away from the disclosure of Matsuura (as noted below, Matsuura is directed to CVD interlevel dielectric films). Either of these facts, standing alone, renders the modifications to the teachings of Morita proposed in the Office Action inappropriate, as a matter of law. Further, the teachings of Morita are rendered unsuitable for their intended purpose

if they are modified as suggested in the Office Action to attempt to arrive at the invention as recited in any of Applicant's claims.

The Examiner correctly notes that "Matsuura expressly indicates that PECVD of $(\text{CH}_3)_x\text{SiO}_y$ is better than spin-on or liquid methods" and notes that the Examiner has made this point before. Such is another example of what is known in legal parlance as "teaching away".

A brief summary of some of the legal implications of "teaching away" is provided for the Examiner's convenience in The Manual Of Patent Examination Procedure, at §2145(X), entitled "ARGUING IMPROPER RATIONALES FOR COMBINING REFERENCES", section D(2), which states, inter alia, that "It is improper to combine references where the references teach away from their combinations."

Applicants note the requirements of MPEP §2141.02, entitled "~~Differences Between Prior Art and Claimed Invention~~", stating that "PRIOR ART MUST BE CONSIDERED IN ITS ENTIRETY, INCLUDING DISCLOSURES THAT TEACH AWAY FROM THE CLAIMS". This MPEP section further states that "A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984)".

Accordingly, and by the Examiner's own admission, there is no motivation (i) to combine the teachings of Matsuura with those of Morita, as a matter of law, or (ii) to modify the teachings of Morita to attempt to arrive at the subject matter of any of Applicant's claims. For at least

these reasons, all of the unpatentability rejections based on Morita are prima facie defective and should be withdrawn, and claims 102-134 should be allowed.

Brinker et al. specifically teach methods of preparing aerogel thin films at ambient pressure (see, e.g., Title, Abstract, Field of the Invention, Summary etc.). Brinker et al. additionally teach (col. 1, lines 28-34) that "To date, however, the potential of aerogels has not been realized in these applications, because conventional supercritical aerogel processing is energy intensive, often dangerous, and, most important, not amenable to continuous or semi-continuous thin-film forming operations such as dip-coating."

Brinker et al. teach (col. 2, lines 16-20) that this results from need, in conventional aerogel processing, for use of an autoclave. In fact, Brinker et al. teach (col. 2, lines 1-20) that such equipment is expensive, dangerous and results in processing as batch operations.

It is Brinker et al.'s primary concern and intended purpose to maintain ambient (i.e., one atmosphere) pressures, to avoid capital-intensive equipment, and to promote continuous processing such as dip coating. Adapting the teachings of Brinker et al. to attempt to arrive at the subject matter of any of Applicant's claims clearly defeats this intended purpose. It is improper to employ a reference in a manner that renders the teachings of the reference unsuitable for their intended purpose. This is explained below in more detail with reference to MPEP §2143.01, entitled "Suggestion or Motivation to Modify the References".

This MPEP section states that "THE PROPOSED MODIFICATION CANNOT RENDER THE PRIOR ART UNSATISFACTORY FOR ITS INTENDED PURPOSE". This MPEP section further states that "If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)."

Accordingly, as a matter of law, there is not suggestion or motivation to modify the teachings of Brinker et al. to attempt to arrive at the subject matter of any of Applicant's claims. For at least these reasons, the rejections based on Brinker et al. are prima facie defective and should be withdrawn, and Applicant's claims should be allowed.

Miyasaka is directed to a "FABRICATION METHOD FOR A THIN FILM SEMICONDUCTOR DEVICE" by forming a semi conductive layer. Forming an insulative layer instead of forming a semi conductive layer, as taught by Miyasaka (col. 4, line 23 et seq., Example 6, see lines 56-59), defeats this intent. There is no teaching in Miyasaka of forming a semiconductive layer atop the layers recited in any of Applicant's claims or of how to form such a layer.

Adapting the teachings of Miyasaka to try to arrive at the invention as recited in any of Applicant's claims defeats Miyasaka's intended purpose and renders the teachings of Miyasaka unsuitable for their intended purpose. As a result, there is no motivation, as a matter of law, to attempt to modify the teachings of Miyasaka to try to arrive at the

subject matter of any of Applicant's claims. The rejections incorporating the teachings of Miyasaka are prima facie defective and should be withdrawn, and Applicant's claims should be allowed.

The Examiner appears to be using an improper "obvious to try" rationale, picking and choosing various elements from the references without regard for the teachings about, or purposes for which, these elements are provided in the prior art, using Applicant's own disclosure as a guide in hindsight reconstruction. Such is improper for several reasons as discussed below in more detail.

Applicants note the requirements of MPEP §2145(X)(B), entitled "Obvious To Try Rationale". This MPEP section states that "An applicant may argue the examiner is applying an improper "obvious to try" rationale in support of an obviousness rejection."

This MPEP section further states that "The admonition that 'obvious to try' is not the standard under Section 103 has been directed mainly at two kinds of error. In some cases, what would have been 'obvious to try' would have been to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful.

In others, what was 'obvious to try' was to explore a new technology or general approach that seemed to be a promising field of experimentation, where the prior art gave only general guidance as to the particular form of

the claimed invention or how to achieve it." *In re O'Farrell*, 853 F.2d 894, 903, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988)."

Further, the Examiner has provided no evidence of motivation to combine the teachings of these references. Evidence of a suggestion to combine may flow from the prior art references themselves, from the knowledge of one skilled in the art, or from the nature of the problem to be solved. However, this range of sources does not diminish the requirement for actual evidence. Further, the showing must be clear and particular. See *In re Dembiczak*, 175 F.3d 994, 998 (Fed. Cir. 1999).

The Examiner also states (p. 6, extending to p. 7) that "absent evidence to the contrary that the dielectric constant is reduced by at least 10% by exposure to the oxygen plasma and that the dielectric constant is inherently stabilized. If it is thought for some reason that the dielectric constant is not reduced or is not stabilized by exposure to the oxygen plasma, then these may be a [sic] difference. But, it has been held, where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on. See *In re Swinhart*, [sic] 169 USPQ 226, 229 (CCPA 1971). See also *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is

based on inherency under 35 USC 102 or obviousness under 35 USC 103). Given the similarity (if not equality) of the dielectric materials formed, the present evidence indicates that the dielectric constant must necessarily be reduced and stabilized." The Examiner is mistaken on multiple grounds.

Guidance in applying the law as discussed in *In re Swinehart and Sfiligoj*, 169 USPQ 226, can be found in MPEP §2183, entitled "Making a Prima Facie Case of Equivalence". This MPEP section states that:

"If the examiner finds that a prior art element performs the function specified in the claim, and is not excluded by any explicit definition provided in the specification for an equivalent, the examiner should infer from that finding that the prior art element is an equivalent, and should then conclude that the claimed limitation is anticipated by the prior art element. The burden then shifts to applicant to show that the element shown in the prior art is not an equivalent of the structure, material or acts disclosed in the application. *In re Mulder*, 716 F.2d 1542, 219 USPQ 189 (Fed. Cir. 1983). No further analysis of equivalents is required of the examiner until applicant disagrees with the examiner's conclusion, and provides reasons why the prior art element should not be considered an equivalent. See also, *In re Walter*, 618 F.2d 758, 768, 205 USPQ 397, 407-08 (CCPA 1980) (a case treating 35 U.S.C. 112, sixth paragraph, in the context of a determination of statutory subject matter and noting "If the functionally-defined disclosed means and their equivalents are so broad that they encompass any and every means for performing the

recited functions . . . the burden must be placed on the applicant to demonstrate that the claims are truly drawn to specific apparatus distinct from other apparatus capable of performing the identical functions"); *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) (a case in which the court treated as improper a rejection under 35 U.S.C. 112, second paragraph, of functional language, but noted that "where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on"); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103)."

Claims 102, 110, 126-129, 133 and 134 include recitation of aspects of the invention relating to changes in dielectric properties, which the Examiner appears to be characterizing as functional description. Of these claims, only 102 and 129 are independent. Accordingly, only these claims could possibly meet the requirement noted above that the recited feature be "critical for establishing novelty in the claimed subject matter". Further, there is no assertion by the Applicants that any "functional" recitation is critical to novelty. Accordingly, the Examiner has failed to

assert even a prima facie showing that the doctrine relied upon is appropriate.

Further, the Examiner has offered no evidence that "indicates that the dielectric constant must necessarily be reduced and stabilized" in the context of the prior art. Accordingly, the Examiner has failed to identify appropriate conditions under which this doctrine could conceivably be applicable.

In Swinehart, the appealed claim read: "A new composition of matter, transparent to infra-red rays and resistant to thermal shock, the same being a solidified melt of two components present in proportion approximately eutectic, one of said components being BaF_2 and the other being CaF_2 ." As may be seen, the issue presented in Swinehart is a narrow issue and depends critically on a number of facts that are materially different in the present situation. As a result, Swinehart is clearly inapposite to any of the presently-pending claims or the previously-filed claims.

Additionally, the statement (p. 13) that "So it is unclear how the presence of water could make a difference in the instant invention", while possibly having limited technical relevance, has NO legal relevance. It is an unsupported personal opinion.

Further, the Examiner states (pp. 12-13) that hydrogen peroxide does not decompose to provide water, and does not contain water. The Examiner then provides an unsupported opinion that hydrogen peroxide decomposes to provide hydroxyl radicals. Applicants disagree.

Applicants note that hydrogen peroxide, oxygen and water are molecules, and, as such, are relatively stable. Hydroxyl radicals are not molecules, and, as such, are intermediary, metastable artifacts. The Examiner's comments seem at best to be disingenuous. Moreover, the Examiner has misconstrued the definition of "dry" oxygen-containing moieties provided in Applicant's disclosure. That definition (p. 7, lines 5-10) is: "a compound that does not either contain water or decompose to form water". This definition is more encompassing than one step in a multistep decomposition process.

Since the Examiner's opinions are not supported by the references, they must be made on the basis of personal knowledge of the Examiner's. Applicants note the requirements of MPEP §1.104, entitled "Nature of examination", which states that "When a rejection in an application is based on facts within the personal knowledge of an employee of the Office, the data shall be as specific as possible, and the reference must be supported, when called for by the applicant, by the affidavit of such employee, and such affidavit shall be subject to contradiction or explanation by the affidavits of the applicant and other persons." In the event that the Examiner persists in stating that hydrogen peroxide does not and cannot decompose to provide water, and that hydrogen peroxide thus fits within the ambit of Applicant's definition of "dry" oxygen-comprising moieties, Applicants call for such an affidavit or other objective evidence to support this position.

Further, Applicant herewith submits a duplicate copy of the Supplemental Information Disclosure Statement and the Form PTO-1449 relevant to foreign references filed in this application on September 25, 2001. No initialed copy of this PTO-1449 has been received back from the Examiner. To the extent that the submitted references listed on the Form PTO-1449 have not already been considered, and the Form PTO-1449 has not been initialed with a copy being returned to Applicant, such examination and initialing is requested at this time, as well as return of a copy of the initialed Form PTO-1449 to the undersigned.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page(s) are captioned "**Version with markings to show changes made.**"

In summary, Applicants having responded to each of the rejections as such rejections apply to new claims 102-134, Applicant respectfully asserts that claims 102-134 are in condition for allowance. Action to that effect is earnestly sought. If, however the Examiner's next action is anything other than a Notice of Allowance, the Examiner is requested to call the undersigned to schedule a telephonic interview. The undersigned is available during normal business hours, Pacific Coast Time.

Respectfully submitted,

Dated: Mar 5, 2002

By: 

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Version with markings to show changes made.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/388,826
Filing Date September 1, 1999
Inventor Weimin (Michael) Li et al.
Assignee Micron Technology, Inc.
Group Art Unit 2813
Examiner E. Kielin
Attorney's Docket No. MI22-1208
Title: Low k Interlevel Dielectric Layer Fabrication Methods

37 CFR §1.121(b)(1)(iii) AND 37 CFR §1.121(c)(1)(ii)
FILING REQUIREMENTS TO ACCOMPANY RESPONSE TO DECEMBER
27, 2001 FINAL OFFICE ACTION
RESPONSE TO ACCOMPANY RCE FILING

Underlines indicate insertions and brackets indicate deletions.

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In the Specification

On page 2, the paragraph spanning from line 5 to line 21 has been amended as shown below:

One way of reducing the dielectric constant of certain inherently insulative materials is to provide some degree of carbon content therein. One example technique for doing so has recently been developed by Trikon Technology of Bristol, UK which they refer to as Flowfill™ Technology. Where more carbon incorporation is desired, methylsilane in a gaseous form and H_2O_2 in a liquid form are separately introduced into a chamber, such as a parallel plate reaction chamber. A reaction between the methylsilane and H_2O_2 can be moderated by introduction of nitrogen into the reaction chamber. A wafer is provided within the chamber and ideally maintained at a suitable low temperature, such as 0°C , and at an

exemplary pressure of 1 Torr to achieve formation of a methylsilanol structure. Such structure/material condenses on the wafer surface. Although the reaction occurs in the gas phase, the deposited material is in the form of a [viscus] viscous liquid which flows to fill small gaps on the wafer surface. In applications where deposition thickness increases, surface tension drives the deposited layer flat, thus forming a planarized layer over the substrate.

The paragraph spanning lines 14-21 on page 4 has been amended as shown below.

In one implementation, a low k interlevel dielectric layer fabrication method includes providing a substrate having integrated circuitry at least partially formed thereon. An interlevel dielectric layer comprising a compound having silicon bonded to both nitrogen and an organic material and having a dielectric constant no greater than 8.0 [over] is formed over the substrate. After forming the dielectric layer, it is exposed to a plasma comprising nitrogen effective to reduce the dielectric constant to below what it was prior to said exposing.

The paragraph spanning from page 7, line 20, to page 8, line 15, has been amended as shown below:

In a more specific example, methylsilane or trimethylsilane is combined with N_2O in a reaction chamber. A pressure within the chamber is maintained at from about 300 mTorr to about 30 Torr, and is preferably maintained at from about 1 Torr to about 10 Torr. An exemplary reaction chamber comprises a spacing between the plates of from about 400 mils to about 600 mils with methylsilane being flowed into the chamber at a rate from about 25 standard cubic centimeters per minute (sccm) to about 2000 sccm (preferably at from about 50 sccm to about 250 sccm). The N_2O is flowed into the reaction chamber at a rate from about 50 sccm to about 3000 sccm (preferably at a rate from about 100 sccm to about 1500 sccm, and more preferably at a rate of from about 500 sccm to about 1200 sccm), and, additionally, helium is flowed into the reaction chamber at a rate of about 500 sccm to about 5000 sccm (preferably from 1000 sccm to about 3000 sccm). A radio frequency (RF) power within the chamber is maintained at from about 50 watts to about 500 watts, and preferably from about 100 watts to about 200 watts. The semiconductor substrate (such as a monocrystalline silicon wafer) is provided within the chamber and maintained at a temperature from about 25° C to about 450° C.

The paragraph spanning from page 11, line 16, to page 12, line 14, has been amended as shown below:

The preferred wafer surface temperature during the exposing is always less than or equal to 550° C, with the exposing also preferably being conducted at subatmospheric pressure. The oxygen comprising plasma is preferably derived at least in part from at least one of O₂, O₃, N₂O, and NO_x. Preferred parameters for the exposing in a dual plate capacitively coupled reactor include an RF power range of from 300 to 1000 watts, a pressure range of from 1 Torr to 6 Torr, a temperature range of from 100° C to 450° C, a spacing between the plates of from 400 to 600 mils, an oxygen gas exposure flow of from 500 to 1500 sccm, an inert gas flow (i.e., He and/or Ar) of from 200 sccm to 800 sccm, and a treatment time of from 20 to 100 to more seconds. It is a preferred intent of the exposing to further not transform [a whole of] the whole or all of the dielectric layer from one base chemistry to another base chemistry by the exposing. An outermost portion of the exposed layer might experience a slight reduction in carbon content, but otherwise that portion and the whole of the layer is not transformed from one fundamental material to another even in spite of the low k reducing or resulting property. In one preferred aspect of the invention, the exposing comprises at least 20 seconds of processing time. More preferably and in preferred sequence, the processing comprises at least 40 seconds, 60 seconds, 80 seconds, and 100 seconds of oxygen containing plasma exposure. The plasma

exposing is preferably ineffective to appreciably etch the interlevel dielectric layer.

The paragraph spanning from page 13, line 16 to page 14, line 2, has been amended as shown below:

An exemplary specific reaction is to combine methylsilane (CH_3SiH_3) with NH_3 in the presence of a plasma to form $(\text{CH}_3)_x\text{Si}_3\text{N}_{(4-x)}$. The exemplary reaction can occur, for example, under the following conditions. A substrate [if] is placed within a reaction chamber of a reactor, and a surface of the substrate is maintained at a temperature of from about 0°C to about 600°C . Ammonia and methyl silane are flowed into the reaction chamber, and a pressure within the chamber is maintained at from about 300 mTorr to about 30 Torr, with a plasma at a radio frequency (RF) power of from about 50 watts to about 500 watts. A product comprising $(\text{CH}_3)_x\text{Si}_3\text{N}_{(4-x)}$ is then formed and deposited on the substrate.

In the Claims

Claims 66-101 have been canceled and claims 102-134 have been added.

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